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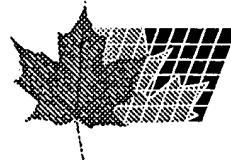
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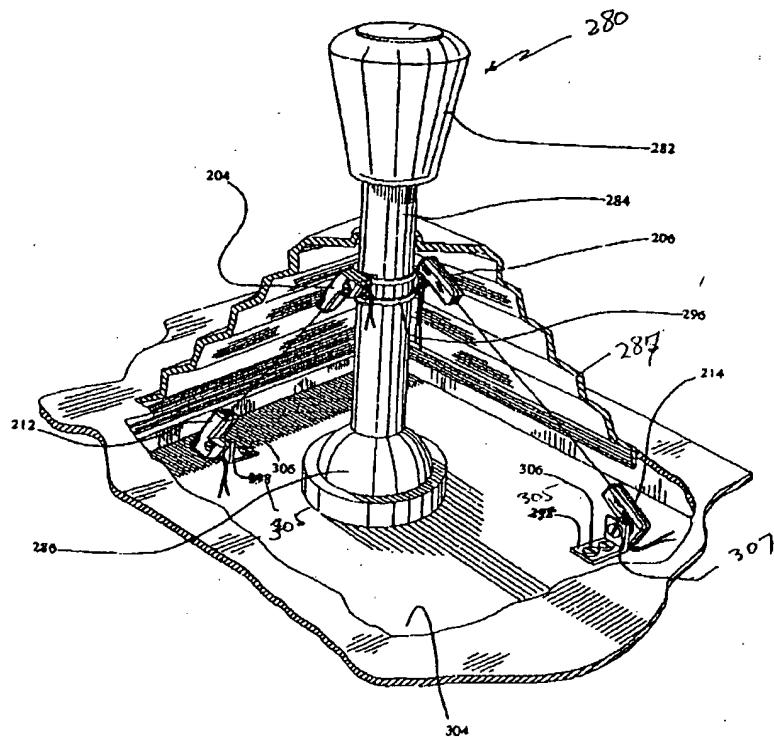
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(72) Dery, Normand, CA  
(72) Santerre, Guy, CA  
(72) Jean, Alain, CA  
(73) ASTROFLEX INC., CA  
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**(54) DISPOSITIF DE VERRROUILLAGE OPTO-ELECTRIQUE  
POUR DEMARREUR D'AUTOMOBILE**  
**(54) AUTOMOTIVE OPTO-ELECTRIC STARTER INTERLOCK**



(57) Cette invention concerne un dispositif électro-optique de neutralisation du démarreur d'un véhicule automobile ayant pour fonction d'empêcher le démarrage à distance du moteur lorsque le sélecteur de vitesses n'est pas au neutre. Ce dispositif fait appel à un ensemble de détecteurs optiques montés sur le sélecteur de vitesses. Il détermine si le sélecteur est au neutre d'après le signal de sortie des détecteurs qui varie selon la position occupée par ledit sélecteur. Un microprocesseur excite des photoémetteurs et contrôle la réponse des détecteurs pour déterminer la position du sélecteur. Les signaux de sortie des détecteurs servent également à détecter les anomalies de fonctionnement du dispositif.

(57) An automotive opto-electric starter interlock for use in a motor vehicle for the purpose of preventing the engine from being remotely started unless the transmission is in neutral. The starter interlock includes an optical sensors array mounted to the transmission shift linkage. The output of the sensors is dependent upon the position of the shift linkage, hence allowing to determine if the transmission is in neutral. A microprocessor excites the sensors and observes their response to determine the position of the shift linkage. The information supplied by the sensors is also used to detect system malfunctions.

**WE CLAIM:**

1. An opto-electric interlock to prevent remote starting of a motor vehicle when a transmission of the vehicle establishes a driving relationship between an engine of the vehicle and a wheel thereof, said opto-electric interlock comprising:
  - a light source for supplying radiant energy;
  - a light detector responsive to radiant energy incoming from said light source, said light source and said light detector assuming a state of optical coupling in response to movement of a shift linkage of the transmission of the vehicle to a spacial position in which the driving relationship between the engine of the vehicle and the wheel thereof is terminated, whereby an output condition of said light detector enables to determine whether the transmission of the vehicle is in gear; ✓
    - a processing unit controlling actuation of said light source, said processing unit being responsive to the output condition of said light detector in order to assume either one of a start enable state and a starter disable state, in said start enable state said processing unit enabling remote actuation of a starter motor of the vehicle, in said starter disable state said processing unit precluding remote actuation of the starter motor, whereby said processing unit is capable of switching between said start enable state and said starter disable
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state in dependence of a spacial position of the shift linkage, said processing unit including diagnosis means for sensing detectable malfunctions in said opto-electric interlock, said diagnosis means including:

5           a) an excitation unit for actuating said light source in a predetermined manner; ✓

b) means for observing the output condition of said light detector; ✓

10           c) a comparing unit for comparing the output condition of said light detector observed at step b) with a response characteristic of the opto-electric interlock in an unimpaired operative condition, upon absence of agreement between the output condition at step b) and said response, said processing unit assuming said starter disable state in order to preclude remote actuation of the 15           starter motor of the vehicle.✓

2.           An opto-electric interlock as defined in claim 1, wherein said excitation unit causes said light source 20           to assume a sequence of operative states at predetermined instants in time.

3.           An opto-electric interlock as defined in claim 2, wherein one of said operative states is actuation of 25           said light source to cause said light source to emit radiant energy during a first time interval.

4. An opto-electric interlock as defined in claim 3, wherein the other of said operative states is de-actuation of said light source, whereby said light source generates no radiant energy during a second time interval.

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5. An opto-electric interlock as defined in claim 4, wherein said processing unit is capable of assuming said starter disable state unless said light detector manifests:

- 10           a) an output condition during said first time interval indicative of presence of radiant energy; and  
               b) an output condition during said second time interval indicative of absence of radiant energy.

15       6. An opto-electric interlock as defined in claim 1, comprising:

              - first and second light sources for supplying radiant energy;  
              - first and second light detectors responsive to radiant energy incoming from said first and second light sources, respectively, said excitation unit actuating said first and second light sources in a predetermined manner.

20       7. An opto-electric interlock as defined in claim 6, wherein said excitation unit causes actuation of said first and second light sources at different instants in time.

8. An opto-electric interlock as defined in claim 7, wherein said processing unit is capable of assuming said starter disable state when either one of conditions a and b are met:

5 a) said first light detector manifests:

an output condition indicative of presence of radiant energy when said first light source is de-actuated and said second light source is actuated; and

b) said second light detector manifests:

10 an output condition indicative of presence of radiant energy when said second light source is de-actuated and said first light source is actuated.

9. An opto-electric interlock as defined in claim 15 7, wherein said processing unit is capable of assuming said starter disable state when either one of said first and second detector manifests an output condition indicative of presence of radiant energy when said first and second light sources are de-actuated.

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10. An opto-electric interlock as defined in claim 7, wherein said processing unit is capable of assuming said starter disable state when either one of said first and second detector manifests an output condition indicative of absence of radiant energy when said first and second light sources are actuated.

11. An opto-electric interlock to prevent remote starting of a motor vehicle when a transmission of the vehicle establishes a driving relationship between an engine of the vehicle and a wheel thereof, said opto-electric interlock comprising:

5            - a light source for supplying radiant energy;  
              - a light detector responsive to radiant energy incoming from said light source, said light source and said light detector assuming a state of optical coupling in response to movement of a shift linkage of the 10 transmission of the vehicle to a spacial position in which the driving relationship between the engine of the vehicle and the wheel thereof is terminated, whereby an output condition of said light detector enables to determine 15 whether the transmission of the vehicle is in gear;

15            - a processing unit controlling actuation of said light source, said processing unit including an excitation unit for causing said light source to assume a sequence of operative states at predetermined instants in time, a first of said operative states corresponding to 20 actuation of said light source to cause said light source to emit radiant energy during a first time interval, a second of said operative states corresponding to de-actuation of said light source, whereby said light source generates no radiant energy during a second time interval, 25 said processing unit being responsive to the output condition of said light detector in order to assume either

one of a start enable state and a starter disable state,  
in said start enable state said processing unit enabling  
remote actuation of a starter motor of the vehicle, in  
said starter disable state said processing unit precluding  
5 remote actuation of the starter motor, whereby said  
processing unit is capable of switching between said start  
enable state and said starter disable state in dependence  
of a spacial position of the shift linkage, said  
processing unit assuming said start enable state when said  
10 light detector manifests:

- a) an output condition during said first time  
interval indicative of presence of radiant energy; and
- b) an output condition during said second time  
interval indicative of absence of radiant energy.

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12. An opto-electric interlock as defined in claim  
11, comprising:

- first and second light sources for supplying  
radiant energy;

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- first and second light detectors responsive to  
radiant energy incoming from said first and second light  
sources, respectively, said excitation unit actuating said  
first and second light sources in a predetermined manner.

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13. An opto-electric interlock as defined in claim  
12, wherein said excitation unit causes actuation of said

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first and second light sources at different instants in time.

14. An opto-electric interlock as defined in claim  
10 13, wherein said processing unit assumes said starter disable state in occurrence of either one of conditions a and b:

a) said first light detector manifests:  
15 an output condition indicative of presence of radiant energy when said first light source is de-actuated and said second light source is actuated; and

b) said second light detector manifests:  
20 an output condition indicative of presence of radiant energy when said second light source is de-actuated and said first light source is actuated.

15. An opto-electric interlock as defined in claim  
12, wherein said processing unit is capable of assuming  
25 said starter disable state when either one of said first and second detectors manifests an output condition indicative of presence of radiant energy when said first and second light sources are de-actuated.

16. An opto-electric interlock as defined in claim  
30 12, wherein said processing unit is capable of assuming said starter disable state when either one of said first and second detectors manifests an output condition

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indicative of absence of radiant energy when said first and second light sources are actuated.

- 5        17. An opto-electric interlock as defined in claim 11, wherein said excitation unit causes said light source to assume said sequence of said operative states in repetition.
- 10      18. An opto-electric interlock as defined in claim 16, wherein said processing unit assumes said start enable state when said detector successively responds with the output conditions a) and b) of claim 1 to a plurality of sequences of said operative states.
- 15      19. An opto-electric interlock as defined in claim 18, wherein said processing unit includes an input for receiving a signal indicative of an operative state of a starter motor of said vehicle, in response to said signal said processing unit assuming either one of a first and second test modes for assessing whether the transmission of the vehicle is in gear, said processing unit acquiring said first test mode when said signal indicates that the starter motor of the vehicle is operating to crank the engine thereof and said second test mode when said signal indicates that the starter motor of the vehicle is inactive,
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5                   i) under said first test mode said processing unit switching to said starter disable state when said detector fails to respond with the output conditions a) and b) of claim 11 to X successive sequences of said operative states,

10                  ii) under said second test mode said processing unit switching to said starter disable state when said detector fails to respond with the output conditions a) and b) of claim 11 to Y successive sequences of said operative states.

15                 20.           An opto-electric interlock as defined in claim 11, wherein said processing unit comprises an input for receiving a signal indicative on an operational state of a parking brake of the vehicle, said processing unit assuming said starter disable state in response to said signal when said signal indicates that the parking brake is released.

20                 21.           An opto-electric interlock as defined in claim 11, wherein said radiant energy is light in the infrared range of the spectrum.

25                 22.           An opto-electric interlock as defined in claim 11, wherein said processing unit comprises an input for receiving an input signal representative of a state of conduction of an electric circuit of the vehicle, the

5           electric circuit acquiring a closed state preparatory to  
              energization of the starter motor of the vehicle, said  
processing unit further comprising an output for generating  
an output signal for controlling a state of conduction of  
10          an electric circuit effecting energization of the starter  
motor of the vehicle, in response to said input signal  
indicating that the electric circuit of the vehicle assumes  
the closed state, said processing unit when in said starter  
15          enable state outputting said output signal to prevent  
              energization of the starter motor of the vehicle.

23.          An opto-electric interlock as defined in claim  
15          22, wherein said output signal drives a power switch in  
              series with the electric circuit effecting energization of  
              the starter motor of the vehicle.

24.          An interlock to prevent remote starting of a  
20          motor vehicle when a transmission of the vehicle  
              establishes a driving relationship between an engine of the  
              vehicle and a wheel thereof, said interlock comprising:  
              - first sensor means responsive to movement of

25          a shift linkage of the transmission, whereby an output  
              condition of said sensor means allows to determine if the  
              transmission of the vehicle is in gear;

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- second sensor means responsive to an operative condition of a parking brake of the vehicle, whereby an output condition of said second sensor means enables to determine whether the parking brake is released or applied;

5 - a processing unit coupled to said first and second sensor means, said processing unit being capable of assuming either one of a start enable state and a starter disable state in dependence upon the output conditions of 10 said first and second sensor means, in said start enable state said processing unit enabling remote actuation of a starter motor of the vehicle, in said starter disable state said processing unit precluding remote actuation of the starter motor, said processing unit including memory 15 means for storing data representative of the output condition of said first sensor means when the output condition of said second sensor means indicates that the parking brake is released, said processing unit assuming said start enable state in response to:

- 20 a) a current output condition of said second sensor means indicates that the parking brake is applied;  
b) a current output condition of said first sensor means indicates that the driving relationship between the engine of the vehicle and the wheel thereof is terminated; and

c) a contents of said memory means indicates occurrence of a driving relationship between the engine of the vehicle and the wheel thereof.

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25. An interlock as defined in claim 24, wherein said first sensor means comprises:

- a light source for supplying radiant energy;
- a light detector responsive to radiant energy

10 incoming from said light source, said light source and said light detector assuming a state of optical coupling in response to movement of a shift linkage of the transmission of the vehicle to a spacial position in which the driving relationship between the engine of the vehicle and the wheel thereof is terminated.

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26. An interlock as defined in claim 25, wherein said processing unit including an excitation unit for causing said light source to assume a sequence of operative states at predetermined instants in time, a first of said operative states corresponding to actuation of said light source to cause said light source to emit radiant energy during a first time interval, a second of said operative states corresponding to de-actuation of said light source, whereby said light source generates no radiant energy during a second time interval, said processing unit assuming said start enable state when said light detector manifests:

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- a) an output condition during said first time interval indicative of presence of radiant energy; and  
5 b) an output condition during said second time interval indicative of absence of radiant energy.

27. An interlock as defined in claim 25, wherein said radiant energy is light in the infrared range of the spectrum.

10 28. A group of opto-electric components for detecting a position of a gear shift linkage in a motor vehicle, said group of opto-electric components comprising:

- 15 - a light source element for generating radiant energy;  
- a light detector element responsive to the radiant energy emitted by said light source element, said light source element and said light detector element being mounted in respective housings, a first one of said housings being capable of engaging the gear shift linkage, whereby movement of the gear shift linkage causes movement of said first housing and the element mounted therein, a second one of said housings being adapted for mounting to a location adjacent the gear shift lever, whereby move of the gear shift linkage causes a relative movement between said light source element and said light detector element, said light source element and said detector elements
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being capable of assuming a state of optical coupling when the gear shift linkage is in a predetermined position in which said light source element generates light within a field of view of said light detector element, in said state of optical coupling said light detector element manifesting an output condition indicative of presence of radiant energy which signals that the gear shift linkage is in the predetermined position.

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29. A group of opto-electric components as defined in claim 28, wherein each said housing comprises:

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- a body of material substantially opaque to said radiant energy;

- an elongated light passage formed in said body for receiving therein one of said elements in a recessed condition relative an opening of said light passage.

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30. A group of opto-electric components as defined in claim 29, wherein said light passage is provided with internal grooves extending generally transversely to a light propagation path through said passage, said grooves constituting means for scattering light reflected on an internal wall of said light passage.

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31. A group of opto-electric components as defined in claim 29, wherein said first housing comprises a gear shift lever mounting member, said member including a

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recessed surface conforming to an outer face of the gear shift lever.

5        32.        A group of opto-electric components as defined in claim 31, wherein said recessed surface is concave.

10        33.        A group of opto-electric components as defined in claim 31, wherein said first housing comprises an aperture for receiving a fastener releasably joining said first housing and said gear shift lever mounting member.

15        34.        A group of opto-electric components as defined in claim 31, wherein said gear shift lever mounting member includes a groove for receiving a tie wrap for encircling the gear shift lever and maintaining said mounting member against the gear shift lever.

20        35.        A group of opto-electric components as defined in claim 31, wherein said recessed surface is coated with adhesive to bond said mounting member to the gear shift lever.

25        36.        A group of opto-electric components as defined in claim 28, comprising:  
                - a first pair of optical elements including a light source element and a light detector element; and

5 - a second pair of optical elements including a light source element and a light detector element, one element of each said first and second pairs of optical elements being adapted for mounting to the gear shift lever of the vehicle.

10 37. A group of opto-electric components as defined in claim 28, wherein said light source element is a light emitting diode capable of generating light in the infrared range of the spectrum.

15 38. A group of opto-electric components as defined in claim 37, wherein said light detector element is a phototransistor responsive to infrared radiation.